Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington DC 20554

In the matter of	)	
	)	
Inquiry Regarding Carrier Current Systems	)	ET Docket No. 03-104
Including Broadband Over Power Line Systems	)	

REPLY COMMENTS OF CLIFFORD E. CHAMNEY, K0BIX

1. Introduction/Summary
:
My interest in this proceeding is I am an amateur Extra Class licensee and active operator, having been licensed almost continuously since 1955. I am also a shortwave listener.

My qualifications to measure are that I have worked doing troubleshooting and repair to the component level, and lab measurements and oversight, for 29 years.

The comments of those supporting BPL generally have not claimed that using a working shortwave amateur radio station at or near a BPL node has not been observed to result in interference to the amateur service. Instead, most manufacturers simply indicate they conform to the Part 15 numerical requirements and have not received reports of interference during trials. In general, no statements are made regarding the sizes of the trial areas, the statistical probability of one or more amateurs or shortwave listeners being near a BPL node, etc. Absent such information a "no interference" report is meaningless.

There is a Comment that a manufacturer went to the home of a radio amateur and observed no interference. How close was the amateur's antenna to a BPL node? Was the amateur use the band the BPL was on? Was the BPL operating on the amateur band spoken of? What were the relative antenna polarities and directionalities? None of these essential details was reported. I ask: how close can an amateur's antenna be to a BPL node?

In contrast, I have conducted practical listening tests at BPL trials and observed interference from BPL to licensed services, as detailed below.

The Commission is asking, among other questions, whether the present Part 15 limits are appropriate for BPL. In general the manufacturers have not provided data to support contentions that there is no potential for interference, the present limits are appropriate, and the limits can even be relaxed. There are merely statements that there were no

interference reports, and those are meaningless absent other information, as I indicated above.

Commission requirements for present carrier current systems contemplated narrowband, isolated, point source stations. Most of these cases are in the AM or FM radio band, where there are strong local signals. Thus the potential for interference is mush less than on the shortwave bands. If there was an interference complaint an unlicensed operator could change frequency a few kilohertz and possibly not interfere with anyone. BPL places broadband signals in bands used for weak signal reception. On overhead power lines, this becomes an area source, even if it is only a small area (down and up the power line). If interference is then caused to a shortwave listener or amateur there are at least two possible compliant responses. The main choices are: notch out a carrier or move the BPL hundreds of kilohertz or megahertz to avoid interference, as some commenters say they will do. Over time the provider might have to notch out tens or hundreds of carriers, if users of licensed and government services could even determine where to complain. If a careful analysis is conducted neither response will prove to be economically practical, because operators underestimate the potential for interference, and manual intervention will be required with each interference report. I believe this degree of manual intervention cannot be tolerated by an operator.

As a result I oppose continued authorization of BPL under the present rules and I oppose relaxation of the rules to accommodate BPL.

2. Interference Observations and Discussion:

2.1. I have observed shortwave radio reception at two BPL locations. One of them utilized OFDM and the other utilized DSSS. Using a sensitive and selective high-end mobile amateur radio communications receiver and a mobile loaded vertical whip antenna, I observed interference to both licensed and government services.

2.2. As location considerations are very important when determining whether interference is in fact an issue, any interference report or estimate (positive or negative) must be carefully evaluated to estimate the actual potential for interference due to any widespread rollout of BPL. Locations must also be separated into underground and overhead BPL categories.

As analog usage of the shortwave spectrum typically involves human listeners, human factors are very important. For example, how important is a background tone or buzz, or static crashes, while copying a voice signal from Australia or listening to an opera on the BBC? In nature static crashes are generally limited to the vicinity of transitory thunderstorms. With DSSS BPL static crashes may be ongoing. As the nature of interference is very important, it must in any case be determined whether the interference observed made listening significantly more difficult or tiring. It is safe to say that, for human analog reception, any noticeable interference increases fatigue. Interference can be so severe as to render a given signal unusable. Simple spectrum analyzer numerical

results, under Part 15, do not provide a necessary subjective evaluation of the severity of interference to human users. A useful measure of interference severity is signal to noise ratio.

2.3. My measurements of DSSS BPL signal strength directly under an overhead medium voltage power line at a BPL node are reported in the following table.

Table 1
Icom IC-706 Mk II S-Meter Readings at the Street at a BPL Node

	Overhead	
	Min.	Max.
DSSS	S9+30dB	S9+40dB

Note 1: Location: directly under and three feet from the power line. Cape Girardeau MO. Corner of Melrose Ave. and Rampart St. Date: July 20, 2003.

Note 2: Absent an S meter, communications practice reports signal strength as S1 (barely detectable) through S9 (very strong). Receiver S meters are not necessarily calibrated to the same standard. Above S9 such meters report additional levels in decibels (dB). Using this receiver I found many usable signals at levels <S1.

Note 3: For overhead power line measurements the mobile vertical antenna was cross polarized to the power line. By a frequently used rule of thumb there was 20 dB of polarization attenuation between the power line and the measuring antenna.

As many usable signals (for example: WWV; amateur morse code signals; international broadcast signals) measured below S1 on this receiver, even the weakest signal reported in the table represents a potential source of serious interference to many shortwave signals.

Signals observed to be interfered with included some on the amateur 10, 21 and 28 MHz bands. Other signals observed to be interfered with included the national frequency and time standard station, WWV, at 10 and 15 MHz, Radio Marti, and numerous international shortwave stations.

Some comments suggested that new radio technologies do or soon will make interference meaningless in the traditional sense. Some people who do not utilize the AM shortwave bands may not realize that part of the appeal and usefulness is talking, as directly as one can using radio, with people in faraway places. Many amateur radio operators and shortwave listeners do not want to use one of the more mechanical means such as digital radio or a computer keyboard and screen for recreational communication. Also while interference to a digital radio may not necessarily cause communication to cease, it reduces information throughput, degrading service to the licensed user. Also, in an emergency a simple inexpensive analog radio can provide communications whereas a

digital radio might be more difficult and time consuming to repair or replace if one of its essential parts breaks.

2.4. Distance from BPL Node where interference can be observed.
This distance depends greatly on whether BPL is installed underground or overhead.

For overhead installations the power line appears to work as a combined antenna and open wire transmission line, as would be expected. Thus BPL interference carries some distance down the wire by conduction, as well as perpendicularly away from the wire by radiation. The amount of radiation from an open wire transmission line depends partly on the balance of the line and feed system. I was able to hear BPL signals several hundred feet down the power line from a source node.

For underground installations the power line seems to act as a transmission line and any nearby metal street lamp pole seems to act as an antenna.

When I looked this month the FCC web page giving information to potential operators of carrier current radio stations indicated that the service range of "campus radio," under current rules, is 200 feet at the AM broadcast band and 100 feet at the FM broadcast band. It is a reasonable assumption that these numbers were heuristic, resulting from multiple observations at multiple locations. Thus it can be assumed that these numbers would apply to BPL interference. Any shortwave antenna within 200 feet of a power line in a neighborhood where BPL is widely deployed would be interfered with if the user was attempting to operate on a BPL frequency band. The degree of interference would depend on the resulting signal to noise ratio. The signal to noise ratio would depend on the relative field strengths or S meter readings of the desired signal and the BPL signal. For comfortable communications a signal to noise ratio of 20 dB is probably required. Thus at the BPL node reported above a distant signal would have to be 50 to 60 dB above S9 to be usable. These are very strong signals, indeed, when a signal <S1 is usable. Amateur radio shortwave could be unusable on multiple frequency bands for an operator located at a BPL node.

2.5. Density of Frequency Coverage.
Some comments suggest the BPL nodes will be so far apart and frequency re-use will be so infrequent that almost no user of the shortwave spectrum will be significantly interfered with. No showings are made to support this contention. It is the responsibility of the advocate for a new user, especially an unlicensed user, of the spectrum to demonstrate a lack of interference to other services. This has not been done.

The fact is that a widespread rollout of BPL will necessitate placing radio frequency currents on every power line in each neighborhood.

To understand the impact of this it is necessary to model the interference footprint of BPL at the frequency bands and power levels to be utilized. Manufacturers have not done this in Comments.

Assuming the following approximations for present technology:

BPL provides a maximum line rate of 20 Mbps (manufacturer data);
Data is bursty in nature (industry knowledge);
An overall average broadband line rate of about 100 kbps may be necessary per residential customer (rough estimate).

Then: one BPL system could serve approximately 200 customers.

And assuming that residences are spaced at 100 foot intervals (my observation for some suburban developments), and if one medium voltage power line serves two adjacent rows of residences (an obvious approximation) then by simple mathematics (200 X (100/2)) one BPL mini system can serve customers over a power line stretching for 1000 feet. Obviously, in some less crowded urban areas this will stretch to 2000 feet and more.

It seems obvious that two BPL nodes can be collocated, sending RF for one group of customers down the wire and sending RF for a second group of customers up the wire. Similarly, at a medium voltage power line "Y," three BPL nodes could be collocated. These seem obvious economical measures for an operator, because fiber or RF backhaul would be more economical. This concept can be expanded to a power line "X". Thus it can be expected that four BPL nodes might produce RF signals spanning 4X4 or 16 MHz at one location. This is over half the shortwave spectrum. This would leave little room for moving BPL bands to accommodate interference reports. I pity the poor shortwave user with a home at such a location.

3. Regulatory Issues.

Important questions include:

- What is the necessary density of BPL nodes for viable service?
- What is density of frequency re-use?
- How far from an overhead power line can BPL cause interference? (My observation indicates significantly farther than 23 meters, at the BPL node; less far the farther down the power from a node line the measurement is made.)
- How far from the power line do amateurs and shortwave listeners install outside antennas? (I have installed antennas about 25 feet of a medium voltage power line.)
- Are amateurs licensed users of the spectrum?
- Do amateurs deserve protection from BPL interference? (In my view, yes.)
- Do shortwave listeners, utilizing foreign licensed bands, deserve protection from BPL interference? (In my view, yes.)

4. Conclusions.

Manufacturers have claimed but have not shown with hard, verifiable facts, that there is no interference and there will be no harmful interference.

I have observed BPL interference and have reported some of it here, along with sufficient technical details to allow someone else to verify my observations.

If BPL is deployed widely BPL RF currents will be on every power line in every neighborhood.

At some BPL nodes half the shortwave spectrum may reasonably be expected to be occupied with BPL signals.

At BPL nodes BPL signals on amateur bands will be strong enough to interfere with all but the strongest amateur stations.

BPL should not be deployed further, the present rules for BPL should be tightened, and the rules for BPL should not be relaxed.

Yours Very Truly,

s/Clifford E. Chamney
t/Clifford E. Chamney
Licensee, amateur radio K0BIX